Active Project (2014 - 2016)

Autonomous Onboard Failsafe System to Mitigate Common Failure Modes of Experimental SUAS, Phase II Project

SBIR/STTR Programs | Space Technology Mission Directorate (STMD)

ABSTRACT

Automation improvements are needed to reduce the dependency on human reflexes and unreliable data links. Modern autopilots are capable of detecting loss-of-GPS and loss-of-communications. There is no mechanism for the aircraft to autonomously return to a safe landing zone under these conditions. Furthermore, experience has shown that existing controllers are not good at detecting bad position data caused by intermittent GPS. These conditions are known to cause flyaways. The only existing protection is the operator. There is currently no automation that can protect an SUAS when the flight controller is unable to recognize that the GPS and comm links are unreliable. A unique feature of the invention is a dual onboard flight controller. One is a failsafe controller, and the other is experimental. The failsafe controller allows access to control outputs by the experimental controller. Meanwhile, it detects conditions such as lack of GPS reliability, imminent airspace violations, flight profile violations, imminent loss-of-control, and loss-of-stability by experimental software. If the failsafe controller detects one or more of these conditions, then it autonomously seizes control authority from the experimental flight controller and navigates the aircraft to a pre-determined recovery spot, using visual navigation if necessary. No comm link is required.

ANTICIPATED BENEFITS

To NASA funded missions:

Once sufficiently matured, the technology developed in this proposed project will reduce cost and improve safety during SUAS flight operations conducted by NASA Langley in support of its own research objectives. The key component of this technology is an extensible flight controller with built-in autonomous failsafe functionality for a variety of hazards which plague flight operations involving experimental control code and experimental payloads. Examples of hazards which could be

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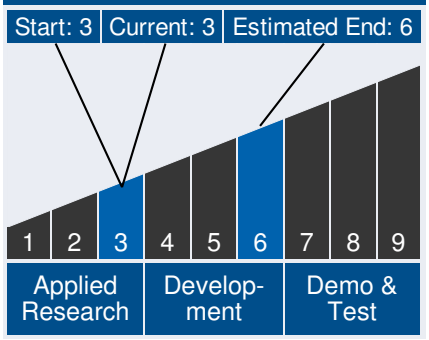
Technology Maturity



Management Team

Program Executives:

- Joseph Grant
- Laguduva Kubendran

Program Manager:

- Carlos Torrez

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autonomously mitigated by the proposed solution include 1) flyaways induced by RF jamming, 2) flyaways induced by poor GPS reception, 3) airspace boundary proximity violation for any reason, 4) loss-of-control due to unsafe attitudes originating from experimental control code, 5) catastrophic loss-of-control due to embedded (experimental) software crash, and 6) flight profile violations due to successful GPS spoofing attacks. Finally, the hardware component of the concept will support development, bench testing, and flight operations with the same hardware, to reduce development costs associated with the porting of software from a development kit to the flight hardware.

To the commercial space industry:

The benefits to NASA listed above are equally applicable to any organization that engages in any research and development involving SUAS. This includes both the SBC (Prioria Robotics) and the RI (University of Florida), but is not limited to them. Furthermore, the solution benefits groups involved in SUAS pilot training, because the extra failsafe autonomy is more frogiving to new pilots.

Management Team *(cont.)*

Project Manager:
- Mark Motter

Principal Investigator:
- Walter Hunt

Technology Areas

Primary Technology Area:
Aeronautics (TA 15)
- Enable Assured Machine Autonomy for Aviation (TA 15.6)
  - Ability to Fully Certify and Trust Autonomous Systems for NAS Operations (TA 15.6.2)
    - Assurance of Flight Critical Systems (TA 15.6.2.1)

Secondary Technology Area:
Communications, Navigation, and Orbital Debris Tracking and Characterization Systems (TA 5)
- Position, Navigation, and Timing (TA 5.4)
  - Sensors and Vision Processing Systems (TA 5.4.3)

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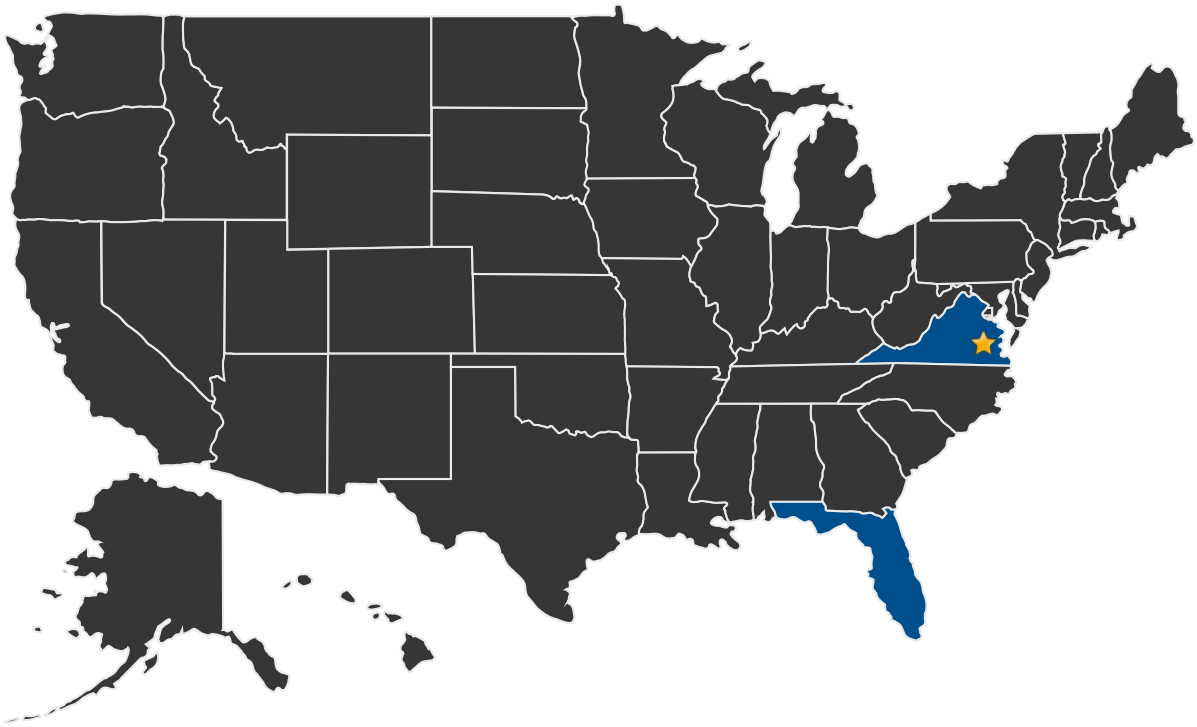
U.S. WORK LOCATIONS AND KEY PARTNERS



U.S. States With Work

Lead Center:
Langley Research Center

Other Organizations Performing Work:

- Prioria, Inc. (Gainesville, FL)
- University of Florida

IMAGE GALLERY

Autonomous Onboard Failsafe System to Mitigate Common Failure Modes of Experimental SUAS

DETAILS FOR TECHNOLOGY 1

Technology Title

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